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ABSTRACT

This booklet on energy is one in a series on environmental education for grades K-12. The activities explore energy use and technology, along with their environmental impact. Five basic behavioral objectives are listed with activity options and appropriate subject areas. Three activities are given for each objective. Information for these includes materials and resources, procedures, and discussion questions. The activities are interdisciplinary and are designed for high school students, grades 9-12. They include role playing, games and simulations, physics experiments, and mathematical calculations. Illustrations, data sheets, worksheets, and tables are also given. (MA)

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ENERGY

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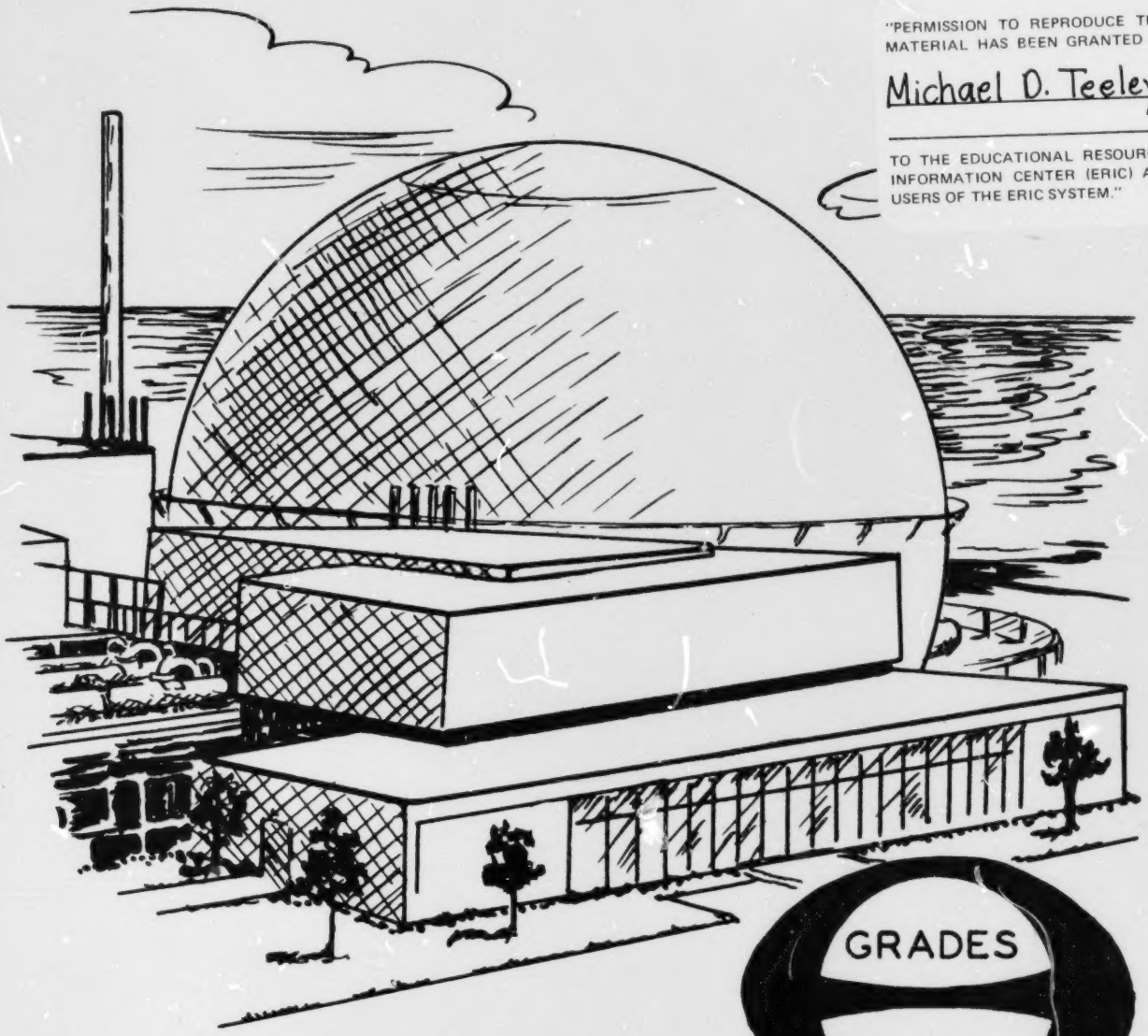

GRADES 6-8

ENVIRONMENTAL EDUCATION

A THEMATIC APPROACH WITH THREE PRONGED INTEGRATION

ANTIOCH COMMUNITY SCHOOL DISTRICT 34

TITLE III ESEA

SE 023 464

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EXPLANATION OF CONCEPT AREA

ENERGY - The need for students to understand more about the concept of energy is obvious with all the controversy in recent months.

In dealing with energy, we begin with merely identifying the Sun as the primary source and establishing our need for energy.

We then help the student to discover the ways energy is used by organisms, including man. This is then built upon to identify the various forms of stored energy and the conversions necessary for effective use of energy.

In the junior high we discuss the effect of culture in determining energy needs. Students then explore the ways we lose energy, the scope of the problem, and future needs and forms of energy.

In high school we explore the various aspects of energy in depth. This deals with usage in the United States and in the World, and the various transformations necessary to make energy readily available. Along with the transformations and technology, we explore the problems to be faced and the potential for solving these problems in a manner which will have minimal environmental impact.

ENERGY 11

BEHAVIORAL OBJECTIVE:

At the completion of this unit the student will be able to explain/illustrate that energy is passed unidirectionally through ecosystems and is rapidly lost according to the laws of thermodynamics.

SUBJECT AREAS:

Science, Mathematics

OPTION #1

MATERIALS AND RESOURCES

Balance and containers
Insect nets
Small shovels

PROCEDURE:

The biomass on a given plot of land can be used as a rough measure of fixed energy. Choose a given natural land area and have the students gather data which will aid them in estimating the biomass of the producers, first order consumers, herbivores and second order consumers, carnivores.

PRODUCERS - green plants:

Weigh the green plant material in 10 plots, 10 cm x 10 cm (each plot = .01 m^2). Include the root systems for each plot. This is best done by digging up each plot and washing off all the soil. Let the sample dry overnight and weight it.

Weight of all ten plots X 10 = biomass/m^2
Biomass/m^2 X total area in m^2 = total biomass of area

FIRST ORDER CONSUMERS - plant-eating animals: (HERBIVORES)

Use insect nets to collect all the insects (theorectically) in four plots, 5 m X 5 m (25 m^2). Weight these <u>before</u> they dry out.

$$1 \quad \frac{\text{Biomass}}{m^2} = \frac{\text{total weight from all plots}}{100}$$

$$1 \quad \frac{\text{Biomass}}{\text{area}} = \frac{\text{biomass}}{m^2} \text{ X total area in } m^2$$

SECOND ORDER CONSUMERS - predators: (CARNIVORES)

Estimate the approximate biomass by observing the approximate number of predators and their mass. Use the same process as for First Order Consumers.

Using it takes about ten units of prey to support one unit of predator. Some typical examples might be:

10,000 kg algae	producer	7225 lb/acre
1,000 kg water fleas	first order consumer	327 lb/acre
100 kg minnows	second order consumer	98 lb/acre
10 kg bass	third	13 lb/acre
1 man	fourth	

OPTION #1 cont.

DISCUSSION QUESTIONS

1. Consider this statement: Usually it takes about ten units of prey to support one unit of predator. Does your data support this reasoning? Explain.

2. What is the original source of the energy in the environment?

3. Is all of this energy fixed by green plants or is some of it dispersed (given off as heat and lost as far as use by an organism is concerned)?

4. When the primary consumers eat the plants, is all of the energy in the plant stored in the consumer's body? Is some of it lost in the normal metabolic processes of its body?

5. As you proceed to consumers of higher and higher order, what happens to the amount of fixed energy that is passed on?

6. Draw a diagram to show how the energy passes through this ecosystem.

FURTHER ACTIVITIES

1. Look up the laws of thermodynamics and determine whether or not your information is consistent with those laws.

2. Have the students explore the idea that in terms of food consumption, soybeans can provide more fixed energy for more people than beef can.

OPTION #1

STUDENT DATA SHEET

ROUGH CALCULATION OF BIOMASS

	Mass/m^2	Mass/acre
Producers	_____ kg	_____ kg/m^2 x 4,047 m^2/acre = _____ kg/acre
1st order consumers	_____ kg	_____ kg/m^2 x 4,047 m^2/acre = _____ kg/acre
2nd order consumers	_____ kg	_____ kg/m^2 x 4,047 m^2/acre = _____ kg/acre

OR

ROUGH CALCULATIONS OF TOTAL NUMBERS*

	Total #/m^2	Total # per acre
Producers	#_____	#_____/m^2 x 4,047 m^2/acre = #___/acre
First order consumers	#_____	#_____/m^2 x 4,047 m^2/acre = #___/acre
Second order consumers	#_____	#_____/m^2 x 4,047 m^2/acre = #___/acre

*Total numbers of organisms can be used as an indicator of the amount of fixed energy at each level if biomass calculation is impractical.

OPTION #2 - two class periods

MATERIALS AND RESOURCES

Paper, pencil, and straight edge

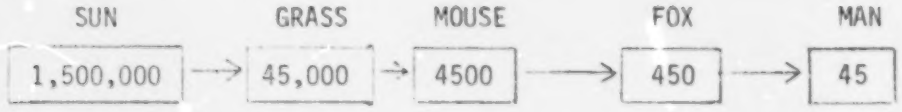
PROCEDURE:

The ultimate source of energy for the earth is the sun. The sun's tremendous energy is deposited in the earth or its atmosphere in a continuous stream. The use of this energy in a food chain can be measured with great difficulty, and some efficiency levels can be determined. From this data we gain some understanding of how the earth uses the sun's energy in life system.

There are several measures of the sun's energy on earth. They usually involve a number or calories per given area per year. One such is the Golley unit which is given in Calories per hundred acres per year. Another is metric and is given in calories per square meter per year. These units result in very large numbers, cumbersone for beginners in mathematics, but when given in scientific notation the numbers are reasonable.

For the purposes of this option, we shall invent a unit, the SUN UNIT, for students in lower levels, so they can grasp environmental ideas while doing simpler math. In addition, for advanced students, we shall use the Golley unit of 1960 and expressions in scientific notation.

One biological note is in order: Practically speaking, each food chain has three or four links, rarely five; and life forms dependent upon fourth link consumption cannot exist. In a food chain, energy is passed on from one holder to another, for example from SUN ⟶ GRASS ⟶ MOUSE ⟶ FOX ⟶ MAN. Each holder has a measurable efficiency for using that energy. Hence, if the sun had an energy level of 1,500,000 units, then the decrease in energy could be illustrated as follows:



From this illustration, if each stage beyond grass had ten percent efficiency, it can be seen that of 1,500,000 units of SUN ENERGY, only 45 finally get to man by this chain. Other food chains will provide different results.

OPTION #2 cont.

Here is a table of a few energy users and their approximate efficiencies in percents.

Grass	3%	Cow (grazing)	25%
Man	10%	Cow (barn fed)	35%
Corn	5%	Chicken	18%
Mouse	2%	Fox	10%
Shrew	1%	Weasel	1%
Hawk	10%		

Objective: Using the data, the student should be able to 1) calculate energy efficiency levels expressed in simple numbers or in percentage; and 2) compare two food chains and tell which one is more efficient.

DISCUSSION AND PROBLEMS:

FOOD CHAIN I

SUN ——→ GRASSES ——→ MOUSE ——→ WEASEL

2,000,000 sun units

1. If the Sun has an energy output of 2,000,000 SUN UNITS, how many Sun units of energy are available to a certain area of earth if 1.3% of the Sun's energy is used? 26,000 SUN UNITS

2. If grasses use only 3% of the energy available to them from the Sun, using the data from problem 1, how many sun units of energy are available to the mouse? 780 SUN UNITS

3. If the mouse uses only 2% of the energy available to him, use the data from problem 2 to determine how many sun units of energy are available to the weasel. 15.6 SUN UNITS

4. What percent of the original sun units (2,000,000) is available in the weasel?

FOOD CHAIN II

SUN ——→ GRASSES ——→ CATTLE ——→ MAN

2,000,000 sun units

5. From problem 2, 780 sun units are available to cattle. If cattle is 25% efficient in using energy, how many sun units are available to man? 195 SUN UNITS

6. If available sun units could be used to say one food is "better" than another, how many times "better" for man is cattle than weasel? 12.5 times better

7. If man needs a constant supply of sun units at 15 sun unit level, could he exist on cattle? yes Could he exist on weasel? no Could he exist on mice? no

8. Barn fed cattle who eat selected grains and grasses have an efficiency of about 35%. If 810 sun units are available from the select food stuff, how many sun units of energy is available to man from barn fed cattle? 283.5 SUN UNITS

9. Comparing your answers in Problems 5 and 8, which cattle would it be best for man to eat? barn fed How many more sun units are available from bard fed cattle than field fed cattle? 88.5 SUN UNITS By what percent are barn fed cattle better than field fed cattle? 31.15%

FOOD CHAIN III

SUN ——→ CORN ——→ COW ——→ MAN

2,000,000 sun units

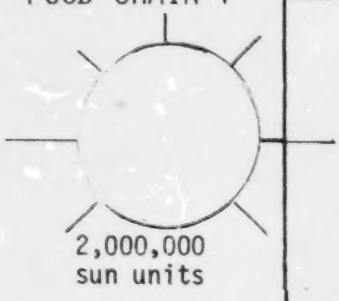
10. If corn is 5% efficient, how many of the 26,000 sun units available to it are made available to the cow? 1300 SUN UNITS

11. How many of these sun units are made available to man? 325 SUN UNITS
Is it wiser for man to be sure his cattle are fed well on corn or on grasses?
corn

12. How much more efficient are corn fed cattle than grass fed?
(325-195) ÷ 325 = .4 40% more efficient

OPTION #2 cont.

CONSIDER THE FOLLOWING FOOD CHAINS AND CALCULATE THE SUN UNITS AVAILABLE AT EACH STAGE OF EACH CHAIN.



13. FOOD CHAIN IV — GRASSES $\xrightarrow{780}$ MOUSE $\xrightarrow{15.6}$ FOX $\xrightarrow{1.56}$ MAN .156

14. FOOD CHAIN V — GRASSES $\xrightarrow{780}$ SHREW $\xrightarrow{7.8}$ WEASEL $\xrightarrow{.078}$ FOX $\xrightarrow{.0078}$ MAN .00078

15. FOOD CHAIN VI — GRASSES $\xrightarrow{780}$ MOUSE $\xrightarrow{15.6}$ WEASEL $\xrightarrow{.156}$ HAWK .0156

16. FOOD CHAIN VII — CORN $\xrightarrow{1300}$ CHICKEN $\xrightarrow{234}$ MAN 23.4

17. Compare food chain III and food chain VII. Is it better for man to eat chicken or cattle? cattle

18. Draw a food chain from sun to man that would represent maximum efficiency, using the elements from the table. Does your food chain reflect the food energy chain used in the United States?

19. The deer consumed 28,000 sun units of energy from foilage and grass, of which 6160 sun units were available for the next element of the food chain. What is the efficiency (in percent) of energy usage for the deer? 22%

20. Rye is a special grass often used for cattle food. If 830 sun units were available from the 26,000 it received from the sun, what is the energy use efficiency rating (in percent) of rye? 35.4%

OPTION #2 cont.

PROBLEMS 21-26 ARE FOR ADVANCED STUDENTS

Scientific Notation. Large numbers may be written in scientific notation usually using three significant digits and a power of ten as a multiply. For instance, 200 may be written in scientific notation by slipping a decimal after the 2 and using a multiply of 100 in the form of 10^2: 2.00×10^2. The decimal usually occurs so that the number part is between 0 and 9.99.

21. Change these numbers to scientific notation.

a. 250 2.50×10^2

b. 65 6.50×10^1

c. 8130 8.13×10^3

d. 1647 1.65×10^3

e. 92.8 9.28×10^1

f. 34,500 3.45×10^4

g. 983,200 9.83×10^5

h. 6,538,000 6.54×10^6

Consider Food Chain I for the following problems:

22. If a mouse utilized 2.50×10^5 units of energy, after receiving 1.58×10^7 units, how many units were lost and what was the rate of efficiency (in percent)?
1.56×10^7; 1.58%

23. The weasel used 5,950 units, leaving 130 units for the next element in the food chains. Write the numbers in scientific notation. 5.95×10^3 and 1.30×10^2
What is the rate of efficiency for the weasel? 2.19%

24. The available energy from the Sun, used by the grass, was 47.1×10^8 units. The weasel produced 130 units for the next element in the chain. From grass ⟶ mouse ⟶ weasel, how many energy units were lost? What was the efficiency rating of the food chain?

$4.71 \times 10^9 = 4{,}710{,}000{,}000$

$4{,}710{,}000{,}000 - 130 = 4{,}709{,}999{,}870$

percent efficiency rating is $1.30 \times 10^2 \div 4.71 \times 10^9 =$

$.276 \times 10^{-7} = .0000000276$ or .00000276%

25. How do you suppose so much energy is lost by each level of the food chain?
respiration, heat, and decomposers

26. Why do cattle and chickens have so much higher efficiency rating than shrew, mice, and weasel? The energy goes into building eatable flesh.

OPTION #2 cont.

STUDENT WORK SHEET

Here is a table of a few energy users and their approximate efficiencies in percents.

Grass	3%	Cow (grasing)	25%
Man	10%	Cow (barn fed)	35%
Corn	5%	Chicken	18%
Mouse	2%	Fox	10%
Shrew	1%	Weasel	1%
Hawk	10%		

Objective: Using the data, the student should be able to 1) calculate energy efficiency levels expressed in simple numbers or in percentage; and 2) compare two food chains and tell which one is more efficient.

DISCUSSION AND PROBLEMS:

FOOD CHAIN I

SUN ——→ GRASSES ——→ MOUSE ——→ WEASEL

2,000,000 sun units

1. If the Sun has an energy output of 2,000,000 SUN UNITS, how many Sun units of energy are available to a certain area of earth if 1.3% of the Sun's energy is used? _____

2. If grasses use only 3% of the energy available to them from the Sun, using the data from problem 1, how many sun units of energy are available to the mouse?

   _____

3. If the mouse uses only 2% of the energy available to him, use the data from problem 2 to determine how many sun units of energy are available to the weasel. _____

4. What percent of the original sun units (2,000,000) is available to the weasel?

   _____ %

FOOD CHAIN II

SUN ——→ GRASSES ——→ CATTLE ——→ MAN

2,000,000 sun units

11

STUDENT WORK SHEET

5. From problem 2, 780 sun units are available to cattle. If cattle is 25% efficient in using energy, how many sun units are available to man? _____

6. If available sun units could be used to say one food is "better" than another, how many times "better" for man is cattle than weasel? _____

7. If man needs a constant supply of sun units at 15 sun unit level, could he exist on cattle?___ Could he exist on weasel?___ Could he exist on mice?___

8. Barn fed cattle who eat selected grains and grasses have an efficiency of about 35%. If 810 sun units are available from the select food stuff, how many sun units of energy is available to man from barn fed cattle? _____

9. Comparing your answers in Problems 5 and 8, which cattle would it be best for man to eat? _____ How many more sun units are available from bard fed cattle than field fed cattle? _____ By what percent are barn fed cattle better than field fed cattle?_____

FOOD CHAIN III

SUN ——— CORN ———→ COW ———→ MAN

2,000,000
sun units

10. If corn is 5% efficient, how many of the 26,000 sun units available to it are made available to the cow? _____

11. How many of these sun units are made available to man? _____
Is it wiser for man to be sure his cattle are fed well on corn or on grasses?
_____

12. How much more efficient are corn fed cattle than grass fed?

40%

12

OPTION #2 cont

STUDENT WORK SHEET

CONSIDER THE FOLLOWING FOOD CHAINS AND CALCULATE THE SUN UNITS AVAILABLE AT EACH STAGE OF EACH CHAIN.

13. FOOD CHAIN IV — GRASSES ——→ MOUSE ——→ FOX ——→ MAN

14. FOOD CHAIN V — GRASSES ——→ SHREW ——→ WEASEL ——→ FOX ——→ MAN

15. FOOD CHAIN VI — GRASSES ——→ MOUSE ——→ WEASEL ——→ HAWK ——

16. FOOD CHAIN VII — CORN ——→ CHICKEN ——→ MAN ——

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20. Rye is a special grass often used for cattle food. If 830 sun units were available from the 26,000 it received from the sun, what is the energy use efficiency rating (in percent) of rye? ____ %

OPTION #2 cont.

STUDENT WORK SHEET

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21. Change these numbers to scientific notation.

a. 250 _____ b. 65 _____

c. 8130 _____ d. 1647 _____

e. 92.8 _____ f. 34,500 _____

g. 983,200 _____ h. 6,538,000 _____

Consider Food Chain I for the following problems:

22. If a mouse utilized 2.50×10^5 units of energy, after receiving 1.58×10^7 units, how many units were lost and what was the rate of efficiency (in percent)?

_____

23. The weasel used 5,950 units, leaving 130 units for the next element in the food chains. Write the numbers in scientific notation. _____
What is the rate of efficiency for the weasel? _____

24. The available energy from the Sun, used by the grass, was 47.1×10^8 units. The weasel produced 130 units for the next element in the chain. From grass ⟶ mouse ⟶ weasel, how many energy units were lost? What was the efficiency rating of the food chain?

_____

_____

_____

_____

25. How do you suppose so much energy is lost by each level of the food chain?

_____

26. Why do cattle and chickens have so much higher efficiency rating than shrew, mice, and weasel?

_____

OPTION #2

DIAGRAM

IF 3000 CALORIES FALL ON ONE SQUARE METER OF ECOSYSTEM PER DAY

ONLY 1500 CALORIES ARE ABSORBED BY PRODUCERS

ONLY 15 CALORIES ARE AVAILABLE TO PRIMARY CONSUMERS

1.5 CALORIES ARE AVAILABLE FOR SECONDARY CONSUMERS

.15 CALORIES ARE AVAILABLE FOR THIRD ORDER CONSUMERS

15

OPTION #3

MATERIALS AND RESOURCES

Flashlight and candle
Exposure meter
White cardboard screen
Record-Observation Sheet

PROCEDURE:

1. Introduce evidences of energy. Energy is in use when one observes one or a combination of the following: light, heat, sound, motion

2. Place a flashlight on a table in a darkened hood.

3. Place a cardboard screen at a given distance from the flashlight and measure the light reflected from the screen.

4. Move the screen back for a specified distance and again read the exposure meter. Record findings.

5. Repeat this process for several more trials. Record again.

6. Following a similar procedure as above but using smaller distance units and a candle, measure the heat from the candle at various distances. Record findings.

DISCUSSION QUESTIONS

1. What happens to the intensity of the light as the screen is moved farther away? What happens to the temperature as the thermometer is moved farther away?

2. Why is the intensity of light on the screen less as you move farther away? Why is the temperature on the thermometer less as you move farther away?

3. Write a statement on a piece of paper and ask different students to read it from varying distances from the candle.

4. How does this model illustrate dispersal of light?

5. How does this model simulate the dispersal of energy in the environment?

   a. What is the source of energy in the environment?
   b. Is all of this energy "fixed" by green plants or is some of it dispersed?
   c. When the primary consumers eat plants in the environment, is all of the stored energy of the plant finally stored in the animal or is some of it lost in the normal processes of animal metabolism?
   d. As you proceed to consumers of higher and higher order, what happens to the amount of energy passed on?

OPTION #3 RECORD-OBSERVATION SHEET

TRIAL	Meter distance from candle	Meter reading	Difference	Thermometer distance from candle	Temp.	Difference
1						
2						
3						
4						
5						
6						

Light intensity observations:

Temperature observations:

ENERGY 12

BEHAVIORAL OBJECTIVE:

At the completion of this unit the student will be able to explain that energy may be transformed but it is neither created nor destroyed.

SUBJECT AREAS:

Science, Physical Education, Home Economics

OPTION #1

MATERIALS AND RESOURCES

DEMONSTRATION

Large pendulum bob, preferably massive in appearance such as an old bowling ball with a figure 8 painted on it for dramatic effect

Wire or string or rope of appropriate strength to secure bob

PENDULUM LABORATORY

String, pendulum bob of metal or wood hooked on with screw eyes
Meter sticks, one or two per set-up
Paper
Supports for pendulum such as laboratory table bars, ring stand, etc.

SPRING LABORATORY - It is necessary to have more than one spring and weight per student group.
Hooke's Law apparatus
Expansion springs and weights
Meter stick
Paper
Supports for springs

PROCEDURE:

1. For the demonstration obtain volunteers from the class by asking, "Who believes in the laws of Science?" When hands are shown, choose a skeptical individual.

2. Stand this student against a wall if possible and instruct him or her not to move.

3. Draw a large pendulum bob up to and pressing against the student's chin. Take bets on the student's continued good health.

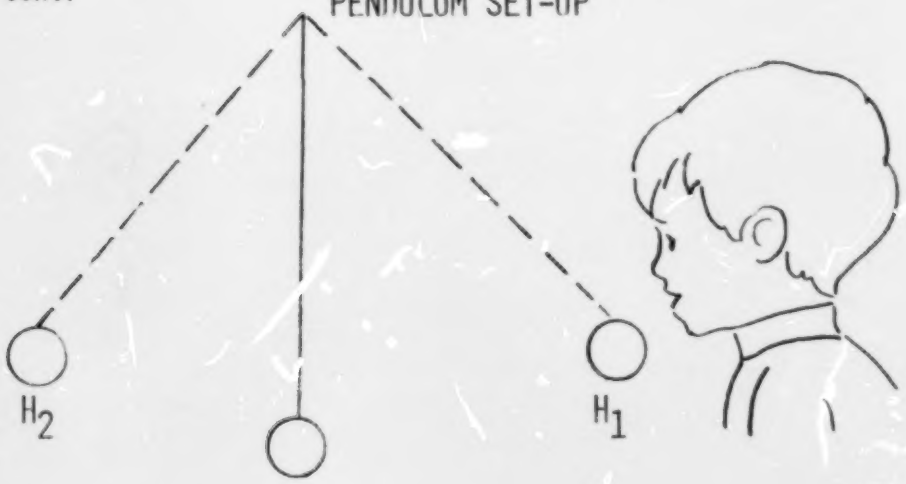
4. Release bob. CAUTION - BE CAREFUL NOT TO PUSH THE BOB AWAY AND REMAIN NEARBY SO THAT THE STUDENT DOES NOT MOVE FORWARD INTO RETURNING BOB. The instructor may wish to substitute the subject's hand instead of his chin.

5. The bob will return to a point just below the student's chin.

6. Proceed to either or both of the labs.

OPTION #1 cont.

PENDULUM SET-UP



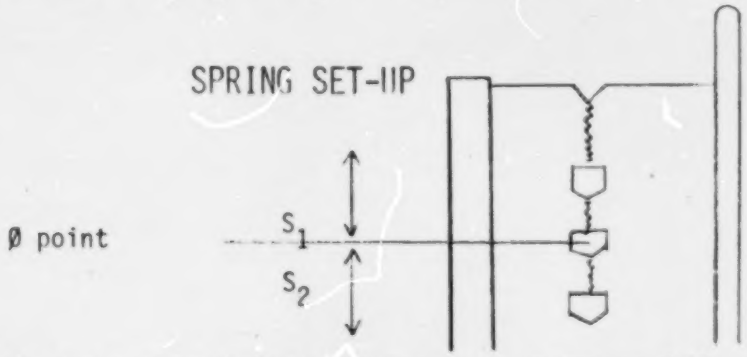
LAB 1 - PENDULUM

1. Several measurements of H_1 should be compared for successive swings. The same comparisons should be made for H_2. Have the students vary the bobs, length of the string, and the height of the release.

2. Students will then compare H_1 and H_2 for different trials.

LAB 2 - SPRING

SPRING SET-UP



Weight should be drawn down (S_2) and released or raised up (S_1) and dropped.

1. Several measurements of S_1 should be compared as weight vibrates. The same comparisons should be made for S_2. Have the students vary weights, springs, and distance of draw (S_2) and/or distance of rise (S_1) within elastic limit.

2. S_2 should be compared to S_1 for different trials.

For both labs H and S can be determined approximately by placing a piece of folded paper as a guide along the vertical meter stick to eye the height of rise and distance of drop.

OPTION #1 cont.

DISCUSSION QUESTIONS

1. How did H_1 change as the pendulum continued to swing?
2. How did H_2 change as the pendulum continued to swing?
3. How does H_1 compare to H_2 in each trial? What is the value of H_1/H_2 in each trial?
4. How did S_1 change as the spring continued to vibrate?
5. How did S_2 change as the spring continued to vibrate?
6. How does S_1 compare to S_2 in each trial? What is the value of S_1/S_2 in each trial?
7. Does H_1/H_2 or S_1/S_2 change for different conditions? Which conditions?
8. Why do the pendulum and spring finally stop? What happened to the energy in the weight and bob when motion ceased?
9. Identify the energy form changes for a complete cycle of the spring and the pendulum.
10. Can you explain why the volunteer did not get hit?

OPTION #2

MATERIALS AND RESOURCES

Calorie Chart and Energy Balance Record

PROCEDURE:

1. Each student should keep a record of his food intake and activities for a specified length of time (for example, three days).
2. Determine the number of calories consumed daily.
3. Determine the number of calories used daily.
4. Record your weight each day.
5. Using a bar graph superimpose the two values on a daily basis.

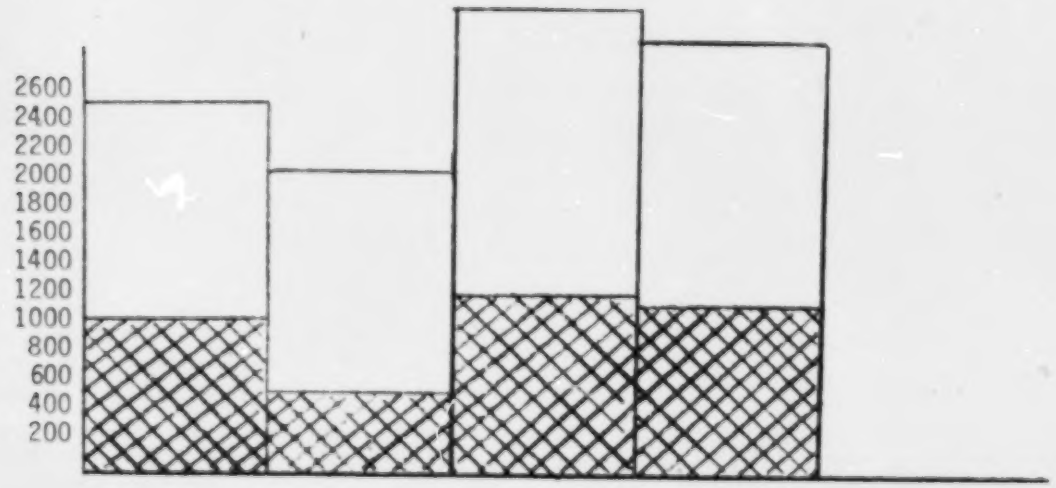
EXAMPLE:

FOOD INTAKE

DAY 1	2500 calories
DAY 2	2000 calories
DAY 3	3000 calories
DAY 4	2800 calories

OUTPUT

DAY 1	1000 calories
DAY 2	500 calories
DAY 3	1200 calories
DAY 4	1100 calories



22

OPTION #2 cont.

DISCUSSION QUESTIONS

1. Analyze your data table and graph. How does your caloric intake compare with your output?

2. Assuming that you did not gain or lose weight each day (energy gain or loss) and your output was less than your input, try to explain where the excess energy went.

3. Would it be accurate to say that the missing energy has been destroyed? Dispersed?

4. What was the source of the energy?

5. What changes in form did the energy take when tracing it from the sun to producers, consumers, and ultimately yourself?

6. Is the conversion of energy from one form to another one hundred percent efficient? Does this help to explain the dispersion of energy?

7. Has energy been created? Destroyed? Transformed?

8. It has been said that there is enough energy in two slices of enriched bread to enable a person to climb Mt. Ranier. Give some reasons why the body cannot convert all this energy to such useful work.

OPTION #2

ENERGY BALANCE RECORD

USE

ACTIVITIES	$\frac{\text{CALORIES}}{\text{HOUR}}$ X FRACTION OF AN HOUR = CALORIES USED			TOTAL
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

ENERGY INPUT

BREAKFAST	CALS	LUNCH	CALS	DINNER	CALS	SNACKS	CALS
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							
9.							
10.							
11.							
12.							
TOTAL		TOTAL		TOTAL		TOTAL	

OPTION #2

Energy Used by 100# person in Calories per hour

Sewing	10-30
Writing	15
Sitting at rest	10
Standing relaxed	15
Dressing and Undressing	20-30
Ironing	40
Dishwashing	40
Sweeping or dusting	50-85
Polishing	100-150
Housepainting	100-150
Carpentering	100-150
Sawing wood	270-400
Walking 2 mph	130
3 mph	160
4 mph	230
Running	530-670
Bicycling 5 mph	190
10 mph	300
14 mph	470
Horseback riding	
walking	100
trotting	340
galloping	400
Dancing	150-270
Gymnastics	150-340
Playing tennis	270-340
Playing Soccer	350
Wrestling	600-700

Calorie Chart (or inexpensive purchased one)

Meats	Calories
Bacon - slices	95
Beef Roast	210
Hamburger 4 oz.	250
Bologna 1 slice	85
Chicken 3 oz.	180
Frankfurter	155
Ham 3 oz.	290
Lamb lean only 2.5 oz.	140
Pork roast 2.5 oz.	175
Sausage 4 oz.	340
Fish 3 oz.	140
Vegetables (1 cup)	
Baked Beans	320
Beets	70
Broccoli, cabbage carrots, green beans	40
Squash, tomatoes	40
Corn	170
Lima Beans	150
Lettuce - 2 large leaves	5
Potatoes (mashed)	150
Desserts	
Cake 1 slice	180
Chocolate layer	420
Candy - chocolate 1 oz.	145
Doughnuts, plain each	135
Ice Cream 1/2 cup	200
Pie 1 slice	300

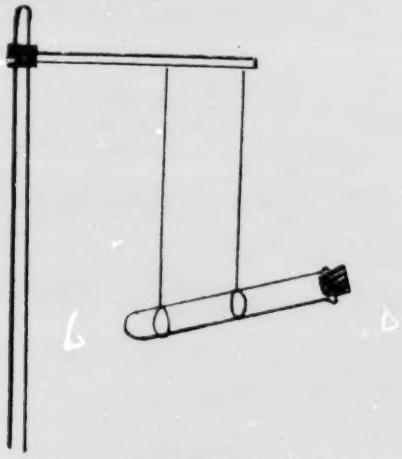
Fruits	Calories
Apple-med.	70
sauce	185
Bananas	85
Cantaloupe 1/2	40
Fruit cocktail 1 cup	195
Orange	65
juice (1 cup)	110
Dairy	
Butter 1 square	50
Cheese 1 oz.	100
Cottage Cheese 1 oz.	30
Eggs - each	90
Milk (1 cup)	165
Salad dressings (1 tablespoon)	110
Breads	
Bread 1 slice	60
Cereals 1 cup	105
Macaroni-spaghetti - 1 cup	155
Pancakes 4" each	55
Rice, noodles - 1 cup	200
Miscellaneous	
Carbonated beverages 8 oz.	100
Cocoa	235
Peanuts 1/2 cup	420
Peanut butter 1 tablespoon	90
Pizza 6" wedge	200

OPTION #3

MATERIALS AND RESOURCES

Large test tube and a cork (not a rubber stopper)
Bunsen burner
Water
Bromo seltzer
Free swinging support for the test tube

PROCEDURE:



1. Set up your recoil demonstration at the front desk as illustrated. Note that the bottom of the test tube is slightly lower than the top and the tube must swing free and clear the support rod.

2. Place a small amount of water in the test tube. Stopper tube but not too tightly! Experiment with proper tightness before class. Test tube may explode if the stopper is too tight! You might choose to use a one-hole stopper with a glass tube inserted and observe the pressure of the steam issuing forth.

3. Heat the water with the bunsen burner to form steam. CAUTION: The pressure will build and blow the cork across the classroom. Do not aim the cork toward the students.

4. Repeat step two adding bromo seltzer to the test tube instead of heating the water. Stopper the tube not too tightly. The reaction will produce gas and the stopper will blow.

DISCUSSION QUESTIONS

1. Describe energy form changes in the first experiment.

2. Describe energy form changes in the second experiment.

3. Where could energy have been "lost" in both these experiments?

4. What did you observe to be the action of the test tube? Why did this occur?

5. What would be the result of doubling the mass of the 1) test tube 2) the cork and 3) both?

6. What happens to the energy applied to the 1) cork and 2) the test tube?

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ENERGY 13

BEHAVIORAL OBJECTIVE:

At the completion of this unit the student will be able to list some possible future forms of energy.

SUBJECT AREAS:

Science, Humanities

OPTION #1 - one to two weeks

MATERIALS AND RESOURCES

Access to the library
Energy! A Study of Resources: Future Alternatives, The Price for Progress, QED fs/c

This World of Energy, Energy for the Future, National Geographic fs/c

Energy Sources: Batteries & Fuel Cells, Geothermal Power, Fusion, Wind, Waves and Sun, BFA fs/c

Reference sheet (attached)

PROCEDURE:

1. Divide the class into groups of six to ten.

2. Each group will be given a different source of energy to be researched and used in the hypothetical situation given in step 3.

3. Each group is in the same following situation:

   a. You are an advance scouting party planning the energy needs for 100,000 people who will be moved into this isolated area of earth, all at one time, in just ten years. You are to plan the energy source for these people in that area.

   b. Present day information

      (1) Every person requires 500,000 BTU's per day.
      (2) The area to be colonized is a nature's paradise - forests, wildlife, clean streams, lakes, and oceans.
      (3) No use of petroleum, natural gas, coal, dams, or nuclear fission is allowed.

   c. Your choice of energy sources

      (1) Fluid-dynamics
          (a) tidal
          (b) wind
          (c) wave
          (d) current gradients

      (2) Geo-thermal
          (a) volcano
          (b) geysers
          (c) hot springs
          (d) drilling and tapping

      (3) Nuclear
          (a) fusion reactors
          (b) breeder reactors

(4) Solar
   (a) solar cells (electricity)
   (b) solar panels (heating)

(5) Combustion
   (a) garbage
   (b) vegetation
   (c) dried feces

(6)* Fuel cells, other exotics such as lasers, hydrogen, thermionic, thermoelectric, carnot cycle, etc.
   (a) hydrogen fuel
   (b) electrolysis

d. Cost: Unlimited expense account is yours. Only the cheapest plan submitted from all the groups will be accepted and graded highest. This is cost per person.

e. Conservation: The best validated statement which shows minimum destruction of the terrain, maximum conservation of resources, wildlife, and vegetation will be graded highest. Energy conservation measures should be added here also as they are a means of resource conservation.

****

f. At the instructor's option the grading on this project may be done in the following manner:

Presentation with bibliography	50%
Participation	50%
in research	20%
in discussion	10%
in presentation	20%

Points will be added to the above grade depending on the place your group finishes. Class vote considering the following criteria:

Most economical
Most ecological
Most workable
Most conservative (conservation wise)

8 points - 1st place
5 points - 2nd place
3 points - 3rd place
2 points - 4th place
1 point - 5th place

*Optional for exceptional students

OPTION #1 cont.

DISCUSSION QUESTIONS

1. Which energy source had the minimum environmental impact? Did any source have no environmental impact? Why?
2. Is the cost for the energy affected by environmental conditions? Is so, what were the conditions? If not, why not?
3. Which forms of energy would provide unlimited use?
4. Is there a way in which the cost of energy can decrease? How?
5. Population increase in this exercise was ignored. Why?
6. Present day energy sources were not allowed to be used? Why?

REFERENCES

Chicago Today: "Heat Your Home With Garbage", November 1972.

Congressional Record: "Solar Energy", June 28, 1972

Earth News: "Solar", April 1973.

Energy and Power: A scientific American collection of energy articles (may not be readily available)

Energy Crisis in Perspective: John C. Fisher, Wiley-Interscience, John Wiley & Sons, New York (1974)

Energy-Environment Sourcebook: National Science Teachers Association (NSTA) Volume I and II (1975)

Environment: "Use of Wastes, Garbage for Energy", December 1971 and "Wind", January/February 1973

Fortune: "Water", November 1970

Life Science Library: "Water", 1969

Popular Science: "Wind", November 1972

Science: "Geothermal", September 1972, "Breeder", September, 1972, "Garbage", November 1972

Scientific American: "Sea Thermal Gradients", September 1971, "Breeder", February 1971

OPTION #1 STUDENT DIRECTIONS

a. You are an advance scouting party planning the energy needs for 100,000 people who will be moved into this isolated area of earth, all at one time, in just ten years. You are to plan the energy source for these people in that area.

b. Present day information

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(3) No use of petroleum, natural gas, coal, dams, or nuclear fission is allowed.

c. Your choice of energy sources

(1) Fluid-dynamics
  (a) tidal
  (b) wind
  (c) wave
  (d) current gradients

(2) Geo-thermal
  (a) volcano
  (b) geysers
  (c) hot springs
  (d) drilling and tapping

(3) Nuclear
  (a) fusion reactors
  (b) breeder reactors

(4) Solar
  (a) solar cells (electricity)
  (b) solar panels (heating)

(5) Combustion
  (a) garbage
  (b) vegetation
  (c) dried feces

(6)* Fuel cells, other exotics such as lasers, hydrogen, thermionic, thermoelectric, carnot cycle, etc.
  (a) hydrogen fuel
  (b) electrolysis

d. Cost: Unlimited expense account is yours. Only the cheapest plan submitted from all the groups will be accepted and graded highest. This is cost per person.

e. Conservation: The best validated statement which shows minimum destruction of the terrain, maximum conservation of resources, wildlife, and vegetation will be graded highest. Energy conservation measures should be added here also as they are a means of resource conservation.

*Optional for exceptional students

OPTION #2 - three days to a week

MATERIALS AND RESOURCES

Energy Sources, fs BFA
Access to the library
Refer to Environmental Ethics 14
Energy-Environment Sourcebook
IIEQ Posters
SIRS - Energy reprints

PROCEDURE:

1. The class is to develop lists of priorities ranking various energy sources under differing criteria. The filmstrips, although broad in scope and basic in content, serve as a good introduction to the various energy forms and could be used as such for the entire class or simply as another reference for research. Possible criteria area:

   a. nearest to realization

   b. most promising in gross power output

   c. most promising in longevity of availability

   d. most compatible with environmental stability (Is it clean?)

   e. receiving the most government funding (research and development)

   f. receiving the most private funding (Commonwealth Edison, Exxon, etc.)

   g. economic feasibility (Is it competitive or can it be?)

   h. most adaptable (location restrictions both geographical and human)

2. After small groups have researched and developed rankings under a single criterion for the various forms of energy (each group should identify and research as many forms as possible in the allotted library time), results should be posted and correlated to determine the order of priority.

3. Provide each small group with a criteria/energy source chart. Tables I, II, and III are provided to give some support for various criteria ranking. Other needed information should be researched. We have provided blank spaces on the chart to add energy sources or criteria the teacher or students may want to include.

4. The point scale is provided to put a quantitative value on choices for averaging and comparing with the other groups.

DISCUSSION QUESTIONS

1. Which energy forms are beyond our present technology? What is being done to explore the possibilities of harnessing these energies?

2. Are energy forms being developed and researched privately also being researched by the government? Why or why not?

OPTION #2 cont.

3. Electric fuel cells and solar cells are fledgling technologies, while the inefficient and bulk battery (storage cell) have been around for decades. Why hasn't more research been put into a portable (chem/electric) power source?

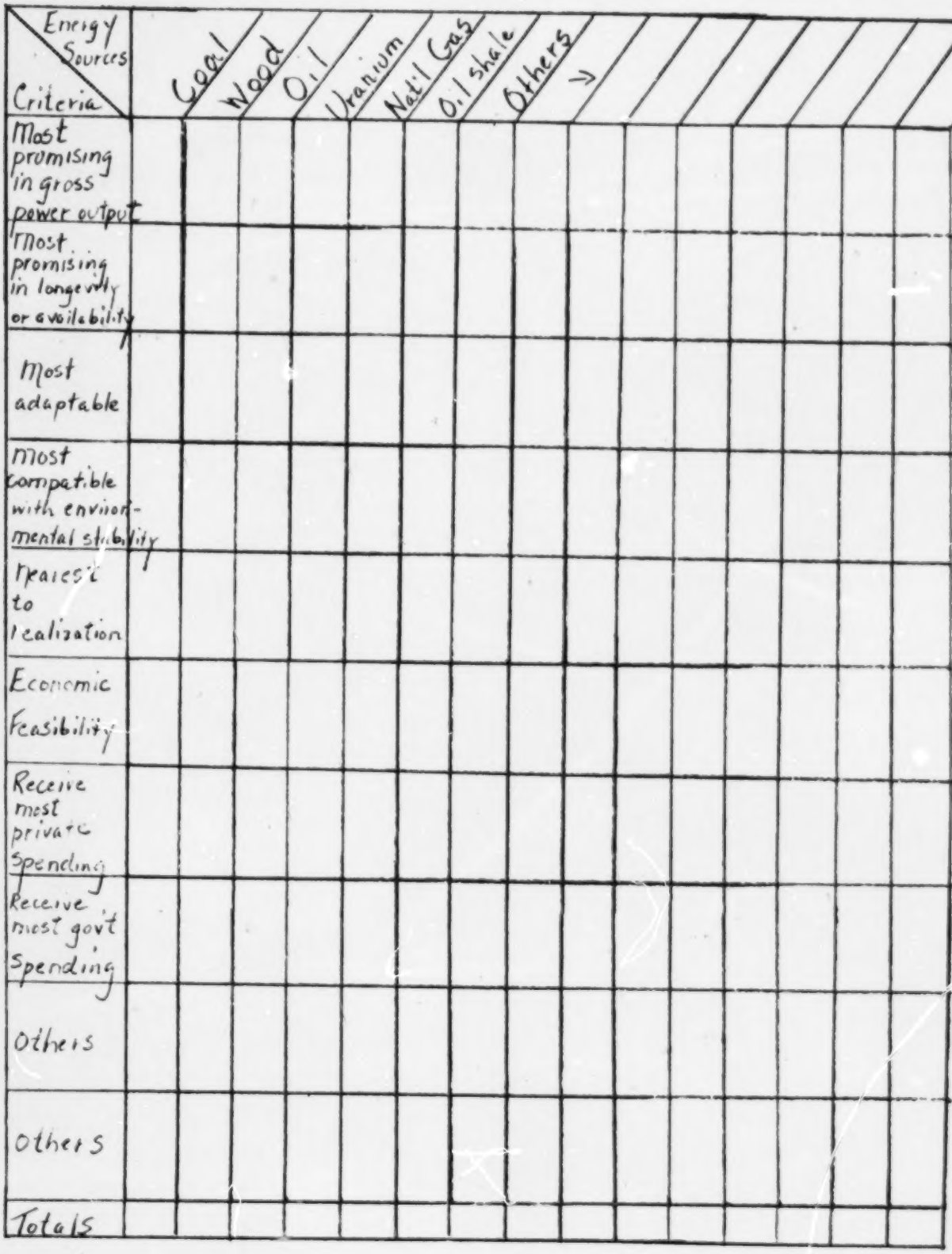
4. Does economic feasibility hinder energy development? In the short run? In the long run?

5. Which criterion has the most influence on energy development in your opinion? Why?

6. How do environmental concerns rate as influencing factors in energy development? Why do you think this is so?

FURTHER ACTIVITIES

Investigate the more exotic forms of energy sources such as 1) graser technology (gamma ray amplification through stimulated emission of radiation) and related micro-fission and micro-fusion) 2) black hole x-ray emission in conjunction with cannibalism of a sister star and 3) matter-anti matter reactions.



Criteria / Energy Source Chart

Point scale 0 — 5 38 — 10

0 Lowest Unacceptable

10 Highest Best

Table 1

Energy Source	BTU/LB	References
Coal	12,000	Table 1-1 p. 105 EESB
Wood	5,000	Table 1-1 p. 105 EESB
Uranium	88,000	Table 1-1 p. 105 EESB
Natural Gas	20,800	Calculated mmm of CH_4 STP Table 2-4 p. 117 EESB
Oil	20,200	Standard Oil, Desplaines 824-5716 42 gal./bbl Range 6830-8320 Average 7.076 lbs/gal or 297 lb/bbl
Shale Oil	20,200	" " "

Table 2

Energy Sources	Known * Reserves (tons)	References
Coal	540 billion	Table 2.2 p. 115 EESB Table 2.9 p. 123 EESB
Wood	Variable	
Uranium	4250**	Table 2.7 p. 121 EESB Table 2.9 p. 123 EESB
Natural gas	7.2 million	Table 2.4 p. 117 EESB Converted Ft^3 to lbs at STP using 16g/MOLE CH_4
Oil	1.1 million	Table 2-3 p. 117 EESB 52 B 661 Table 2.9 p. 123 EESB
Shale oil	81 billion	Table 2.5 p. 118 EESB 600 B bbl

* Represents recoverable proven mineable reserves of known deposits as of 1972.

** Represents the amount of fissionable uranium (U^{235}) in the 250 million tons of mineable ore.

Table 3

Energy Source	Cost per million BTU's	References
Coal	$2.07	Table 1 p. 213 EEMUG
Wood	$2.00	Table 1 p. 213 EEMUG
Uranium	$4.00	Call to Commonwealth Edison 6/20/77 14.2 mills/Kw hr
Natural Gas	$2.16	$1.34/1,000 SIRS Energy Reprint #2 or Time: May 7, 1973
Oil	$1.57	$9.35/bbl Average using values in SIRS Energy reprint #49 or Nat'l Observer 1-5-74
Shale Oil	$1.60	$6/bbl p. 118 EESB

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OPTION #3 - three weeks of student preparation time and about four class periods for the option

MATERIALS AND RESOURCES

Current magazine and newspaper articles
Vertical file on Energy, E^2 Office
BSCS pamphlets
Bulletin board area

PROCEDURE:

1. Introduce the concept of energy and energy sources.

2. Ask the students to watch newspapers and magazines for a three-week period looking for any article(s) that directly or indirectly suggests an energy source. Each article should have key phrases which suggest or infer an energy source. (Alternative - maintain a clipping file.)

3. Allow a few minutes of time each day for the students to post their articles on the bulletin board. Place the articles in categories of related forms such as those listed below:

Geo-Thermal	Fluid Dynamics	Nuclear	Chemical	Solar
volcanoes	tides	fission	combustion	
geysers	wind	fusion	chem-electric	
	hydro-electric		a. fuel cells b. batteries	

4. At the end of the three-week period review the entire collection of articles and solidify the categories.

5. Assign groups of students to each category and give them about two class periods to research that energy form in the library.

6. Upon returning to class each group should discuss the positive and negative aspects of each energy form including efficiency, cost, long and short term effect on the environment, and availability.

DISCUSSION QUESTIONS

1. Which energy forms are beyond our present technology? What is being done to explore the possibilities of harnessing these energies?

2. Are energy forms being developed and researched privately also being researched by the government? Why or why not?

3. Electric fuel cells and solar cells are fledgling technologies, while the inefficient and bulky battery (storage cell) have been around for decades. Why hasn't more research been put into a portable (chem/electric) power source?

OPTION #3 cont.

4. Do the leading forms of energy in terms of desirability have correspondingly high priorities in impetus? If not,why not?

5. Does economic feasibility hinder energy development? In the short run? In the long run?

6. Which criterion has the most influence on energy development in your opinion?

7. How do environmental concerns rate as influencing factors in energy development? Why do you think this is so?

ENERGY 14

BEHAVIORAL OBJECTIVE:

At the completion of this unit the student will be able to identify some of the potential problems associated with new energy sources.

SUBJECT AREAS:

Science, Social Studies, English

TION #1

MATERIALS AND RESOURCES

Energy Environment Game (self-contained), available E^2 Office

PROCEDURE: The procedure is detailed in the players guide; pay particular attention to pages 3, 4, 5, 6, 7, 8, 9, and 15. The following are some additional pointers.

1. On the first day assign people to roles and give a brief explanation of role-playing plus the flow chart. Be certain to mix together volatile types and people of varying abilities.

2. On the same day play the introductory filmstrip record. Note the variety of reference materials available.

3. On subsequent days complete the remainder of the game. Beware of the confusion in the groups over roles. All people have two roles. Be flexible with time and encourage involvement.

4. When you regroup them be certain to clarify the stage of action involved at each time.

5. Watch time very carefully and try to avoid interfering more than is necessary.

DISCUSSION QUESTIONS

1. What did you feel was the most difficult aspect of this problem?

2. Is this the best way to resolve future problems? Explain.

3. Which problems did you find unexpected?

4. Do you feel we must take hurried action or become more cautious about energy? Explain.

OPTION #2

MATERIALS AND RESOURCES

Filmstrips, Energy - A Study of Resources, available E^2 Office
Energy Worksheet

PROCEDURE:

1. Ask the students to list as many energy sources as they can. Briefly discuss the impact of each upon the environment.
2. Distribute the worksheet and allow the students to complete it.
3. Have the students compile resources on energy sources of the past.
4. Develop a time line to illustrate our increasing dependency on energy over time.
5. Show the filmstrips.
6. Using the information from the filmstrips and verticle file, determine what new environmental problems may result from each future energy source.

DISCUSSION QUESTIONS

1. Which forms of energy were used by early man?
2. Did these forms of energy have an impact on the environment long ago? Today?
3. Which forms of energy do we need most for survival?
4. Could we survive without fission and fusion or any other new sources of energy?
5. How could fission affect our environment? Fusion? Geo-thermal power? Solar energy?
6. Is it necessary to utilize many kinds of energy? Explain.
7. How long does it take to make new energies available?
8. Can technology keep track of new energies?

OPTION #2

ENERGY WORKSHEET

Ways in which we utilize ENERGY	Source(s) of ENERGY	Was this ENERGY used: 900 AD	1876	1976	Problems associated with its use
EXAMPLES:					
Preparing food	gas	no	no	yes	
	electricity	no	yes	yes	
	fire	yes	yes	yes	
Defense	fission	no	no	yes	
	fusion	no	no	yes	
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					

OPTION #3

MATERIALS AND RESOURCES

"The Future of Energy"
"Using Energy" SVE filmstrips/cassettes
Values questions tally sheet

PROCEDURE:

1. Show the filmstrip "Using Energy".

2. After showing the filmstrip, hand each student a values questionnaire to complete.

3. When they have completed them survey the room for an average rank for each question.

4. Discuss the rankings for questions 1, 2, 5, 7, and 9 with the following in mind:

   1. The statements were all accurate but they were distorted to create a specific response from us.

   2. They may or may not be solved depending upon world priorities and the advance of energy research.

   5. We must always worry about energy because of our needs and the difficulty of using coal.

   7. Electricity cured the problems of oil and coal fumes and for a short period it was considered a miracle.

   9. We did cut back and if the incentives were right we could do more with a good informational program.

5. Now, after the students have had a night to think about the discussion, show the second filmstrip, "The Future of Energy".

6. After the filmstrip review the values questionnaire and ask the students what rankings they would change, if any.

7. What do they see as the real problems associated with energy use?

OPTION #3 VALUES QUESTIONNAIRE DITTO

Rank each question from 1 to 10 based upon 1 being a factual statement, 10 being total fiction, ridiculous, and 2-9 being somewhere between these extremes.

*1. All of the statements in the filmstrip were true and more people should realize how bad things really are. _____

*2. Our problems with energy will be solved within 20 years. _____

3. Industry uses most energy and they should solve the problems of supplying energy. _____

4. Automobiles are more efficient than bikes or motorcycles. _____

*5. With 300-400 years worth of coal in the United States we shouldn't worry about energy. _____

6. Technology is not a problem it is only our misuse of technology. _____

*7. Electricity has always been a cause of pollution for us. _____

8. Nuclear energy is a form of fossil fuel. _____

*9. There is no way U. S. citizens could cut back their energy use by 20%. _____

10. Energy is only a problem for the U. S. The other countries have all the energy they need. _____

ENERGY 15

BEHAVIORAL OBJECTIVE:

At the completion of this unit the student will be able to explain the effect legislation can have on energy consumption.

SUBJECT AREAS:

Government, English, History

TION #1

MATERIALS AND RESOURCES

Governmental legislators
State troopers
Authorized representatives of
E.P.A.
power company - D. R. Gaul and M. C. Kynell, Commonwealth Edison
gas company
petroleum industry
U. S. News and World Report
The Congressional Record
Technical publications of E.P.A. (Call E.P.A. for latest data.)

PROCEDURE:

1. Using a variety of resources of the type listed above, investigate the 55 MPH speed limit as a preliminary case study. Identify the origin of the legislation, obstacles preceding its enactment, difficulties in its enforcement, and the actual amount of energy that it has saved.

2. Having acquired some feeling for this type of legislative process, the students will separate into five groups. Each group will write a sample law, referred to hereafter as a proposal, designed to conserve some form of energy. When the proposals are finished, the groups will exchange and critique them.

3. The class will then determine which one of these proposals would stand the best chance of accomplishing its stated objective of reducing energy consumption.

4. Copies of the proposal will then be distributed to various individuals and groups for their reaction. A parent, for example, might fill out a questionnaire designed to sample reaction to such legislation. A legislator or a member of the E.P.A. might be invited to speak to the class on the merits of such a proposal. The power company, gas company, or petroleum industry might participate in similar fashion.

5. If it can be shown that the proposal, as written, contains weaknesses that would make it ineffective, the various representatives mentioned above might suggest refinements that would strengthen it. Such refinements would then be built into the final proposal.

6. As a follow-up, the class might contact a political representative to see if he or she would be interested in proposing such legislation on the state or national level.

DRIVING 55: IS THE DOUBLE NICKLE WORTH A DIME? ANSWERING SOME CHARGES AGAINST THE NEW NATIONAL SPEED LIMIT

As memories of the 1973-74 oil embargo fade, many Americans are questioning whether we should remain a National of lightfoots on the accelerator or whether we should again become a land of 55 mph-plus roadrunners.

A recent Gallup survey tells us that many older, middle-class adults resent the 2½-year old speed limit. Gallup explains that when it comes to energy-saving programs, the concepts of waste and success can become fused in their in their minds: "We have saved to become rich; once affluent, we waste to publicize our success." According to Gallup, asking those who have achieved the American Dream to slow down is asking them to forego the proof of their prosperity.

College students and teenagers may also be susceptible to anti-55 attitudes, Gallup reports, because they are unmoved by many of the arguments used in support of the speed limit. They don't respond to glamorless, energy conservation appeals based on self-denial. Nor are they interested on conserving gasoline because it is the patriotic thing to do.

So, to defend 55 to those drivers who doubt whether it is still a good idea, Energy Reporter responds to a speeder's arguments:

SPEEDER: A driver saves gasoline not by slowing down, but by changing driving habits. That is, he can save enough fuel to justify a heavier foot on the accelerator if he eliminates nervous braking, doesn't tailgate, and maintains a consistent speed.

ER: Wrong. Imposing a lower speed limit has saved the country more than 100,00 barrels of oil a day. And, for those who don't care about saving fuel, savings in dollars can be persuasive. Maintaining a consistent speed can squeeze about one extra mile out a gallon, but driving at excessive speeds almost always involves an unavoidable amount of tailgating and braking. Furthermore, no improvement in driving technique can save as much money as, simply, slowing down. Most autos get about 25 percent or four more miles a gallon on highways at 50 mph, and about 20 percent or about 3 more m.p.g. at 55, than at 70. An average driver can save $157 a year by not exceeding the speed limit; compact-car owners can save even more. Even the seemingly harmless thrill of a jackrabbit start costs money.

SPEEDER: Trucks burn more fuel at 55 mph than at higher speeds.

ER: Wrong. One test shows a driver of a 65,000-pound 13½ foot van tractor/semi-trailer combination can get 5.1 miles per gallon if he makes effective use of top gears and holds his speed to 55. By exceeding the limit, his mileage is reduced to 4.51, according to "A Trucker's Guide to Fuel Savings", published last March by FEA, the Environmental Protection Agency, and the Department of Transportation.

SPEEDER: Highway fatalities are caused by bad weather, junk cars, booze, drugs, and the physical disabilities of the driver - not speed.

ER: Wrong. In the first year after the 55-mph limit was enacted, highway fatalities dropped by 11,000 - an 11-year low. While the number of cars on the highway that year was probably lower than usual, reduced speeds accounted for about half of the fatality decrease. If a car involved in a crash is speeding, the chances of death are increased. Every doubling of a car's velocity quadruples its kinetic energy - the force that turns against passengers when their auto hits a solid object. Speeding also magnifies the effects of alcohol, faults in tires and headlights, and any inadequacies in road design.

SPEEDER: Police don't enforce the 55-mph limit.

ER: Wrong. Citations have increased since 1973 in every state except Alaska, and have doubled or tripled in Texas, Wyoming, Utah, and California, among others. And, from 1973 to 1974, highway speeds dropped, on the average, from 60.3 to 54.8 mph.

With all its proven benefits, the 55-mph limit remains under fire by critics who somehow confuse "slower" with "worse". Of course, the criticism must be viewed in the context of the millions of Americans who have accepted the slower pace.

Gallup says that on balance our culture is experiencing a slight trend toward "quality of life" issues over "materialistic success". Just as millions of Americans have endorsed environmental goals, they have also recognized the value of adopting more energy-aware lifestyles. As long as this trend continues, the roadrunner mentality of our speeder may become a relic of the 1950's, when power under the hood was more important than savings at the pump. Is the double nickle still worth a dime? Ultimately the answer is up to all of us.

Taken from Energy Reporter, Federal Energy Administration Citizen Newsletter, August/September 1976.

OPTION #1 cont.

DISCUSSION QUESTIONS

1. Whose responsibility is it to initiate energy legislation?
2. In the case of the 55 MPH speed limit, did any special interest groups try to prevent the passing of the law?
3. How difficult has it been to enforce this speed limit? What special problems have developed?
4. How much energy has been saved through the enactment of this law? Can this saving be readily determined?
5. How does one decide which energy problems require immediate attention? Whose responsibility is it to make this determination?
6. To what extent would special interest groups be affected by these five proposals? How are these groups likely to respond? How might their objections be dealt with?
7. Are energy producers always interested in conserving energy?
8. What criteria will be used to determine which of the five proposals would have the best chance of becoming a workable law?
9. What is the commonly accepted format for a legislative bill? How should it be written?
10. How does one go about getting a legislator interested in pushing a bill through his respective assembly?

OPTION #2

MATERIALS AND RESOURCES

Role sheet

PROCEDURE:

1. Give each student a role sheet.
2. Assign a team of students to roles.
3. Set the scene at 1980. Gas is at a premium. Gas allotment is a must. Each person must make a plea for a set amount of gas.
4. All vehicles described get 20 miles per gallon.
5. Average person drives 1000 miles monthly and uses 50 gallons of gasoline.
6. Each group must prepare a short verbal argument as to why they need gas. This argument should be prepared by consulting an outside resource person who has had experience in one of each of the role areas.
7. Assemble class as a city council. Appoint a chairman and proceed with verbal pleas. Allow time for questioning each time.
8. After all teams have presented their views the class acting as a council must allot 400 gallons of gas among the ten "roles" according to their needs.

DISCUSSION QUESTIONS

1. How fair was the system of alloting gas?
2. What other method could be used?
3. As an individual, what are your feelings about the gas given you?
4. How can we better prepare ourselves to avoid such an allotment situation?
5. What are some other resources which man has wasted to such an extent?

ROLES

Doctor

Your office and home are in the same building but the hospital where you perform your surgery is five minutes away. You also make housecalls. (1000 miles monthly)

Grocery store owner

As a grocery store owner you have always advertised FREE DELIVERY and to stop this practice might affect your business by as much as fifty percent. Your home is one mile from your store. (1000 miles monthly)

Attorney

Your suburban home is twenty miles from your office. There is no public transportation available. You also travel to court every day which is another ten miles daily. (1500 miles monthly)

Tradesman

Your carpentry and plumbing work take you all over the city. You only live eight miles from your shop but you drive about 1000 miles monthly on your job.

Teacher

You live fifteen miles from the school where you teach. Your wife also teaches and has her own auto which she drives to her school ten miles from home. (1500 miles monthly)

Traveling salesman

You travel about 2000 miles monthly. Without gasoline, you will not be able to sell your products.

Farmer

Your farm equipment uses gasoline and you must transport your goods to market. You are the only local farmer and you supply everyone else with their footstuff. (2000 miles monthly)

Housewife

You need your auto for shopping, driving the children around, and for bridge club. Your husband works two jobs so you really have no other means of auto transportation. (750 miles monthly)

Serviceman

You service everything from TV sets to manual pencil sharpeners. Your housecalls use up about 1,500 miles monthly.

Politician

Your travels through the community take you away from your office for at least 2000 miles monthly. It is a necessity to get out to meet the public.

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OPTION #3

MATERIALS AND RESOURCES

Chart of Energy Costs of Beverage Container Systems

PROCEDURE:

1. Study the chart carefully.

2. Attempt to develop generalizations concerning the amount of energy used for each type of container, the impact that each has on the environment, and the relative cost to the consumer.

3. Determine what kinds of legislation might be effective in reducing energy consumption in this industry.

DISCUSSION QUESTIONS

1. Calculate the total BTU's used for each type of bottle listed.

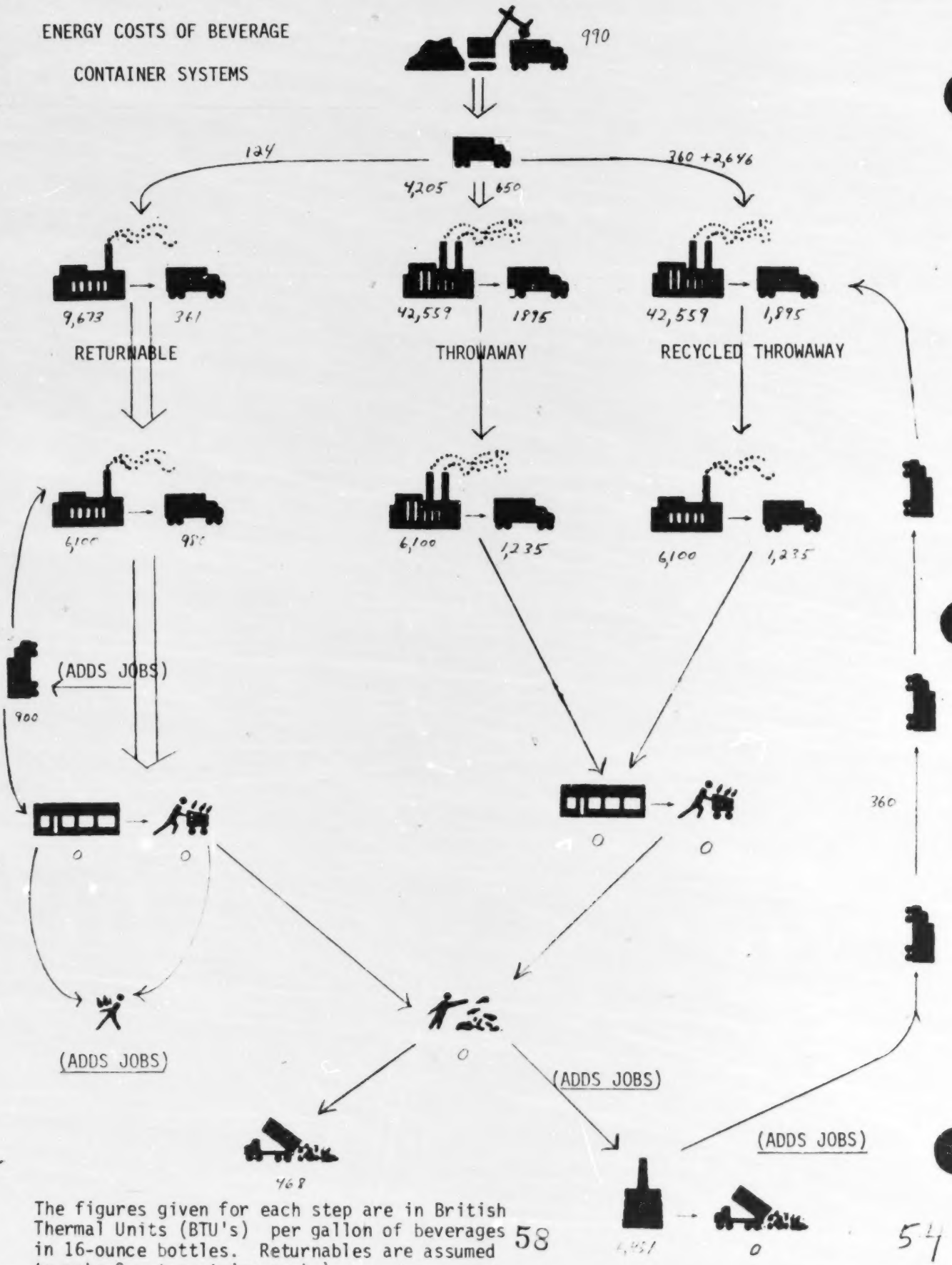
2. What type of bottle requires the least energy consumption to bring the product into the consumer's home?

3. Why do manufactures sometimes prefer the more costly alternative types of containers for their product? Consumers?

4. If you were a legislator, what type of bill could you propose that would benefit the greatest number of people and still conserve energy?

5. What can the individual do about getting effective legislation passed to help conserve energy?

ENERGY COSTS OF BEVERAGE CONTAINER SYSTEMS



The figures given for each step are in British Thermal Units (BTU's) per gallon of beverages in 16-ounce bottles. Returnables are assumed to make 8 return trips each.)